Biela's Comet and the Large Meteors of November 27–30. By Professor Daniel Kirkwood.

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The well-known catalogue of Greg, published in the Report of the British Association for 1860, p. 115 *et seq.*, designates the last days of November as one of the dates at which an unusual number of fire-balls and meteoric stones had fallen since the commencement of the nineteenth century. In the Danville Quarterly Review for December, 1861, the gradual dissolution of Biela's comet was suggested as the source of those periodic displays,* and the same theory was again advanced in the author's "Meteoric Astronomy" (1867), pp. 54, 121, and 126–129. The suggestion has also been made independently by others.

We give below the most distinguished star showers derived from the scattered portions of Biela's comet :—

1798. 7 December ; recognized as Andromedes by Newton.
1830. 7 December ; Quetelet's catalogue.
1838. 5 to 7 December ; recognized by Newton.
1850. 29 November ; Quetelet.
1872. 27 November.
1885. 27 November.

From 1798 to 1885, we have eighty-seven years $= 6.692 \times 13$; and the series is harmonized in the following scheme :—

$$\begin{aligned} 1798 \text{ to } 1838 &= 40 \text{ years} = 6 \times 6.66 + \\ 1830 \text{ to } 1850 &= 20 \quad " \quad = 3 \times 6.66 + \\ 1838 \text{ to } 1872 &= 34 \quad " \quad = 5 \times 6.80. \\ 1872 \text{ to } 1885 &= 13 \quad " \quad = 2 \times 6.50. \end{aligned}$$

The dates, it will be observed, indicate considerable extension of the cluster, or rather, perhaps, the existence of several groups.

The remarkable fall of meteoric iron during the shower of Bielids on the 27th of November, 1885,† at once suggests the inquiry whether traces of the same period can be found in the recurrence of fire-balls and aerolites at the identical epoch. The following dates, except the last, are all derived from the catalogue of Mr. R. P. Greg :—

1809. 29 November ; a fireball at Munich.
1810. 28 November, 9.30 P. M. ; an aerolitic meteor at Cape Matapan.

* "The division of Biela's comet into two distinct parts suggests several interesting questions in cometary physics. * * * May not the force, whatever it is, that has produced *one* separation, again divide the parts? and may not this action continue until the fragments become invisible? According to the theory now generally received, the periodic phenomena of shooting stars are produced by the intersections of the orbits of such nebulous bodies with the earth's annual path. * * * May not our periodic meteors be the *débris* of ancient but now disintegrated comets whose matter has become distributed around their orbits?"—*Danville Quarterly Review*, Dec., 1861, p. 637.

† Amer. Journ. of Sci., March, 1887.

1820. 29 November; a very brilliant meteor at Cosenzo, Ionian Isles.
1821. 28 November; a fireball at Naples.
1821. 30 November; a fireball at Delitzsch.
1822. 30 November, before sunset; a fall of several aerolites at Futtehpore, Doab, India.
1823. 27 November; a fireball at Naples.
1824. 27 November; a fireball as large apparently as the moon, at Prague.
1833. End of November; a fall of aerolites by which a person was killed at Kandahar, Afghanistan.
1834. 29 November; a stone-fall at Raffaten, Hungary.
1834. 30 November; a fireball at Naples.
1839. 29 November, before sunset; a large fireball at Naples.
1842. 30 November; a shower of meteoric stones; specific gravity 3.36; N. E. of Ahmedabad.
1847. 29 November; a brilliant fireball at Bonn.
1848. 29 November; a fireball at Lincolnshire.
1850. 28 November; a fireball at Nottingham.
1850. 29 November; a fireball at London, Oxford, etc.
1850. 30 November; a stone-fall in India.
1859. 28 November; a brilliant detonating meteor, S. W. of Bohemia.
1885. 27 November; the fall of meteoric iron in Mexico (Am. Journ. Sci., Mar., 1887).

These twenty falls may be arranged as follows:—

1809 to 1822	= 13	years	= 2 × 6.50.
1810 to 1823	= 13	"	= 2 × 6.50.
1820 to 1833	= 13	"	= 2 × 6.50.
1821 to 1834	= 13	"	= 2 × 6.50.
1822 to 1842	= 20	"	= 3 × 6.66.
1824 to 1850	= 26	"	= 4 × 6.50.
1834 to 1847	= 13	"	= 2 × 6.50.
1822 to 1848	= 26	"	= 4 × 6.50.
1839 to 1859	= 20	"	= 3 × 6.66.
1859 to 1885	= 26	"	= 4 × 6.50.

The period is apparently well marked, though facts, as with the associated shooting stars, indicate the existence of several clusters moving in orbits very nearly identical. The period is short, thus affording frequent opportunities for studying the group—one of the most interesting with which we are acquainted. The next return may be expected in 1892. It will, of course, be carefully observed.

The comet of Biela was first observed in 1772, but previous traces of its *débris* may not be impossible. Instance the great meteor of December 5, 1762, and the fall of shooting stars on December 5, 1741, referred to in Quetelet's catalogue.